

**DECLARATION OF MARK E. GRISMER, Ph.D.**

I, MARK E. GRISMER, Ph.D., declare and state as follows:

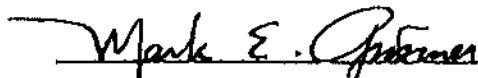
1. I am a consultant in the field of vadose zone engineering and hydrology with over 20 years experience in teaching and research related to irrigation-drainage and soil salinity processes. A current curriculum vitae detailing my qualifications and experience is attached to this declaration.

2. I have been retained by the Metropolitan Water District of Southern California (Metropolitan) to assist it in evaluating the amount of Colorado River water needed to satisfy reasonable and beneficial uses within the Imperial Irrigation District (IID).

3. My opinions, findings and conclusions concerning this matter are summarized below and are discussed in detail in the attached May 28, 2003 memorandum to Principal Engineer Kirk Dimmitt, Subject: Feasibility of Using "Reduced-Runoff" Surface Irrigation for Hay Crops Grown on Heavy Clay Soils in the Imperial Valley.

4. The opinions, findings and conclusions detailed in the attached memorandum are based upon my own personal and professional knowledge of and expertise in the matters that are addressed and, if called as a witness, I could and would testify competently thereto.

I declare that the foregoing is true and correct and that this declaration was executed in Sonoma County, California on May 28, 2003.

  
MARK E. GRISMER, Ph.D.  
Consultant to Metropolitan in the fields of  
hydrology and biological and agricultural  
engineering

## **Mark E. Grismer**

Professor of Hydrology and Agricultural Engineering  
Departments of Land, Air and Water Resources and  
Biological and Agricultural Engineering  
University of California  
Davis, CA 95616  
(530) 752-3243

### **EDUCATION**

- Ph.D. – Agricultural Engineering, Colorado State University (1984)  
Study Emphasis: Groundwater Hydrology
- M.S. – Environmental Engineering, Oregon State University (1981)  
Study Emphasis: Hydrology and Water Quality
- B.S. – Agricultural Engineering, Oregon State University (1980)  
Study Emphasis: Soil and Water Science
- EIT – Engineer-in-Training Registration, Oregon (1980)

### **HONORS**

- Outstanding Teamwork Award & Prize, UC Division of Agriculture & Natural Resources (2003)
- Outstanding Teacher Award, Environmental Resource Sciences Major, UC Davis (1992)
- Mined Land Reclamation Group Graduate Fellowship, CSU  
Environmental Resources Center (1983)
- ASAE Student Honor Award, Oregon State University (1980)  
Honors Program, Oregon State University (1980)
- High Scholarship Graduate, Oregon State University (1980)
- Presidential Scholarship, Hamline University, MN (1976)

### **UNIVERSITY EXPERIENCE**

**Professor**, Departments of LAWR and Biological and Agricultural Engineering, UC-Davis; 7/95-present.

**Associate Editor**, ASCE Journal of Irrigation & Drainage Engineering; 7/94-12/96.

**Master Advisor**, Hydrology; 7/94-7/98

**Master Advisor**, Environmental & Resource Sciences; 7/2003-present

**Graduate Advisor**, Hydrologic Sciences; 7/92-present.

**Chair**, Hydrologic Sciences Graduate Group, UC-Davis; 7/90-7/93 and 7/2002-present.

**Associate Professor**, Departments of LAWR and Agricultural Engineering, UC-Davis; 7/89-6/95.

As an associate professor, I have continued work as outlined below as well as serve on additional college and campus committees. These include chairing an undergraduate major review committee and chairing the Academic Senate and College Rules & Jurisdiction committees during a period of numerous rule changes resulting from integration of Cooperative Extension into the College. Also, as chair of the Earth Sciences & Resources Graduate Group, I was responsible for transformation of this Group into the new Hydrologic Sciences Graduate Group and the creation of Hydrology undergraduate teaching programs (new major and minor). My efforts in curriculum development also resulted in my chairing a graduate education oversight committee for the College.

**Assistant Professor**, Departments of Land, Air & Water Resources (LAWR) and Agricultural Engineering, UC-Davis; 10/84-6/89.

As an assistant professor, my research program considered near surface processes such as infiltration, surface evaporation and irrigation management, as well as various aspects of shallow groundwater including; vapor movement in unsaturated soils, lateral subsurface flows, seepage from wastewater impoundments, groundwater modeling, soil salinity and drainage of cracking clay soils, and regional modeling of shallow groundwater as affected by irrigation and drainage (see publications). In addition to regular teaching, research and committee responsibilities, I served as Chair of the Committee of Consultants on San Joaquin River Water Quality, Chair of a faculty position (geohydrology) search committee, and Chair of the interdisciplinary Graduate Program of Earth Sciences and Resources.

**Research Associate**, Department of Agricultural and Chemical Engineering, Colorado State University; 1/84–9/84.

As a research associate, I was responsible for completion of contracts with oil shale processing companies and consulting firms relative to the leaching of spent oil shales. This work involved laboratory leaching column and hydraulic property studies, as well as, a conceptual mass balance estimate of seepage/drainage from spent oil shale piles in the field.

**Research Assistant**, Department of Agricultural and Chemical Engineering, Colorado State University; 7/81–12/83.

During this period, I completed classroom and laboratory studies toward the Ph.D. In the laboratory, gamma ray attenuation methods were devised for simultaneously monitoring water and salt movement in relatively dry soils.

**Research Assistant**, Department of Agricultural Engineering, Oregon State University; 6/80–6/81.

In this year, I completed coursework in hydrology, water chemistry, and adult education, as well as, M.S. thesis work related to fecal coliform contamination of Tillamook Bay from land application of dairy wastes.

**Engineer-in-Training**, Oregon Soil and Water Conservation Commission, The Dalles, OR; 6/79–9/79.

As an intern, I worked with USDA-SCS personnel on the design, layout and surveying inspection of earthen terraces constructed to limit hillside erosion from dryland wheat fields.

## TEACHING RESPONSIBILITIES

**Principles of Hydrology** (HYD/ERS 100 & 100L, 6 units) – Large enrollment course including multiple laboratory and discussion sections for environmental science students covering all aspects of general hydrology as well as basic hydrogeochemistry and hydraulics.

**Seepage and Drainage, Irrigation and Drainage** (HYD 140, HYD 115/EBS 145, 4 units) – An engineering principles and design course considering subsurface drainage issues associated with excess rootzone drainage, seepage from canals or impoundments and artesian groundwater conditions.

**Multi-phase Transport in Soils, Infiltration and Drainage** (HYD 244/EBS 240, 3 units) – A graduate course considering two and three-phase flow through porous media and its application to infiltration and vadose zone processes. Students design and complete research projects of interest as part of the course.

**Wood Properties & Fabrication** (ABT 15, 2 units) – A basic materials course with multiple laboratory sections considering wood as a biological material, its physical properties (e.g. strength, density, thermal conductivity), mechanics of materials and construction of wood hand planes.

**OSHA HAZWOPER Training** (HYD 410, HYD 440, 1&3 units) – OSHA 10-hr and 40-hr certification courses required before entering hazardous material sites.

**Hydrologic Science Seminar** (HYD 200, 1 unit) – Graduate seminar course considering basic literature review, proposal writing and lecture principles combined with attendance and review of seminars related to hydrology.

## RESEARCH AREAS

**Field Research** – General hydrology and irrigation and drainage engineering. Extensive field research conducted related to irrigation, soil salinity and cracking, and drainage as well as general water quality issues associated with agricultural runoff. Current field research is considering erosion and riparian systems, restoration of tidal marshes via drainage channel design and construction, role of wetlands in watershed systems and use of constructed wetlands for treatment of agricultural process (e.g. winery, fruit) wastewaters.

**Laboratory Research** – Soil physics. Ongoing research related to measurement of soil hydraulic parameters, multi-phase transport through soils, adsorption/desorption of VOC's on clay minerals, strength of clays and general aspects of flow in porous media.

**Modeling Research** – Surface runoff and shallow groundwater systems. Have completed extensive modeling of the impacts of regional irrigation/drainage on soil salinity and shallow groundwater, river water quality, pesticide runoff from orchards and seepage from impoundments.

## CONSULTING PROJECTS (selected)

- Levee seepage* – Modeled timing and extent of levee seepage near Sacramento for CA State Attorney General.
- Santa Rosa Regional Wastewater Treatment System* – Expert reviewer of draft EIR document development.
- Subsurface Drainage System Design* – Developed new design that incorporated an old system for the CA Department of Corrections doubling expansion of an existing prison in the San Joaquin Valley.
- Lincoln City, CA Aggregate Mining* – Expert reviewer of Draft EIR document on behalf of concerned citizen group (WPCARE) of Placer county.
- Fresno, CA Aggregate Mining* – Expert reviewer of Kings River Sand & Gravel Project Draft EIR document on behalf of concerned citizen group.
- Orchard Surface Drainage* – Surveyed and developed remedial drainage design for orchard near Gridley, CA.
- Livingston Waste Water Treatment Plant* – Evaluated declining percolation pond seepage rates and problems associated with river discharge of partially-treated effluent and recommended plant modifications to maintain compliance with waste discharge requirements.
- La Conchita Ranch Orchard Seepage Evaluation* – Conducted extensive field monitoring program and sampling to estimate avocado/citrus orchard water use and rootzone drainage relative to rainfall induced seepage through the vadose zone.
- Evaluation of Dry/Linda Creek Flood Control Project* – Expert reviewer of draft EIR document on behalf of concerned citizen group and Sierra Club to determine potential for downstream flooding resulting from the project and developed possible alternative flood-control designs to reduce loss of "heritage" oak trees along riverbanks and protection of chinook salmon run for presentation to Roseville City officials and FEMA.
- Evaluation of District Canal Seepage Problems* – Assisted in conducting a field survey and analysis of shallow groundwater levels as they were affected by operation of a water district canal for orchard near Gridley, CA.
- Independent Review Panel Expert on Agricultural Water Conservation for CALFED*. Advised CALFED officials about proposed evaluation of agricultural water use efficiency around the state related to the Delta water issues.

## CONFERENCE PUBLICATIONS

- Moore, J. A., M. E. Grismer, S. R. Crane, and J. R. Miner. 1982. Evaluating dairy waste management systems' influence on fecal coliform concentration in runoff. ASAE Paper No. 82-4024.
- McCullough-Sanden, B. L., T. K. Gates, and M. E. Grismer. 1986. Analysis of seepage in an on-farm evaporation pond. ASAE Paper No. 86-2064.
- Grismer, M. E. 1987. Water vapor adsorption kinetics during constant-rate infiltration. ICIDA Conference, Hawaii. January.
- van der Tak, L. D. and M. E. Grismer. 1987. Irrigation, drainage and soil salinity in cracking soils. ASAE Paper No. 87-2052.
- Grismer, M. E. 1987. Automated monitoring of remote soil sensors. ASAE Paper No. 87-2095.
- Gates, T. K. and M. E. Grismer. 1987. Stochastic optimal management of saline perched aquifers in irrigated regions. Proceedings of International Conference on Groundwater Contamination: Use of models in Decision-Making. Amsterdam, The Netherlands. October.
- Tod, I. C. and M. E. Grismer. 1988. Drainage efficiency and cracking clay soils. ASAE Paper No. 88-2588. December.
- Grismer, M. E. 1989. Drainage efficiency and drain water quality. In: Proceedings of the Eleventh International Congress on Agricultural Engineering, Dublin, Ireland. September. pp. 285-290.
- Grismer, M. E. 1990. Deep percolation, drainage and water quality. In: Proceedings of the ASCE National Conf. on Irrigation and Drainage Engineering. July. pp. 355-362.
- Lyons, T. C. and M. E. Grismer. 1992. Management of agricultural drainage pollution considering regional cooperation. In: Proceedings of the ASCE National Conf. on Irrigation and Drainage Engineering. July.

- Grismer, M.E., F. Karajeh and H. Bouwer.** 1993. Evaporation pond hydrology. *In: Proceedings of the ASCE National Conf. on Irrigation and Drainage Engineering*, Durango, CO. July.
- Bali, K. M. and M. E. Grismer.** 1993. Measurement of multi-phase flow in relatively dry porous-media. ASAE Paper No. 932063. June.
- Bali, K. M. and M. E. Grismer.** 1993. Calibration of dual-energy gamma systems for determining liquid saturations during multiphase flow in soils. *International Conf. on Physical Properties of Agricultural Materials*, Bonn, Germany. Paper No. 93-1007. Sept. Also in *Int'l Agrophysics* 8:1-8.
- Bali, K. M., M. E. GRISMER, K. S. Mayberry and J. M. Gonzalez.** 1994. Temporal and spatial variability of infiltration in heavy clay soils. ASAE/ASCE International Summer Meeting, Kansas City, MO. Paper No. 94-2044.
- Bali, K.M. and M.E. Grismer.** 1995. Management of surface irrigation systems in heavy clay soils. *In: Proceedings of ASCE Intl. Conf. on Water Resources Engr., San Antonio, Texas.* pp. 1590-94.
- Guitjens, J.C., J.E. Ayars, M.E. Grismer and L.S. Willardson.** 1995. Irrigation/drainage practices for water quality management. *In: Proceedings of ASCE Intl. Conf. on Water Resources Engr., San Antonio, Texas.* pp. 927-931.
- Ayars, J.E., M.E. Grismer and J.C. Guitjens.** 1995. Water quality as a design criteria in irrigation and drainage water management systems. *In: Proceedings of ASCE Intl. Conf. on Water Resources Engr., San Antonio, Texas.* pp. 932-936.
- Grismer, M.E.** 1996. Emerging concepts for management of salinity and drainage in irrigated regions. *In: Proc. of N. American Water and Environ. Congress.* Anaheim, CA. June.
- Tod, I.C. and M.E. Grismer.** 1996. Efficiencies of drainage systems and improved water management. *In: Proc. of N. American Water and Environ. Congress.* Anaheim, CA. June.
- Bali, K.M. and M.E. Grismer.** 1996. Water management and irrigation scheduling of sudan grass in clay soils. *In: Proc. of N. American Water and Environ. Congress.* Anaheim, CA. June.
- Grismer, M.E., J.L. Kollar and J. Syder.** 1998. Drainage design for restoration of San Pablo Bay tidal wetlands. *Soc. Wetland Sci. Annual Meeting, Anchorage, AK.* June. Abstract, p.112.
- Grismer, M.E., H.L. Shepherd and M. Tausendschoen.** 1998. Subsurface flow hydraulic characteristics of a constructed wetland for winery effluent. *Soc. Wetland Sci. Annual Meeting, Anchorage, AK.* June. Abstract, p.49.
- Shepherd, H.L. M.E. Grismer, and K. Sanders.** 1998. Treatment efficiency of a subsurface flow constructed wetland for winery effluent: Application of a rate-dependent decay constant *Soc. Wetland Sci. Annual Meeting, Anchorage, AK.* June. Abstract, p.47.
- Bali, K.M. I.G. Escobosa, J.N. Guerrero, D.M. Crohn and M.E. Grismer.** 1998. Effects of biosolids on infiltration in clay soils. ASAE Annual Summer Meeting, Orlando, FL. July. ASAE Paper No. 98-2114.
- Grismer, M.E.** 1998. Wetland hydrology and water quality assessment. Keynote Address *In: Proc. of Int'l Symposium on Lowland Technology, Saga University, Japan.* Nov. pp.35-48.
- Watanabe, H., M.E. Grismer, J.D. Henderson and B.W. Wilson.** 1998. Nonpoint source pollution control of diazinon in dormant-sprayed orchards: Use of inter-row vegetative filter strips – A multi-system approach. Presentation at *Int'l Symposium on Lowland Technology, Saga University, Japan.* Nov.
- Shepherd, H. L.; Grismer, M. E. and Sanders, K.** 1999. Constructed wetlands used for improving quality of winery process wastewater. (Annual Meeting of the American Society for Enology and Viticulture Reno, Nevada, USA June 30-July 2). *American J. of Enology and Viticulture* 50(3):371.
- Tod, I.C. and M.E. Grismer.** 1999. Irrigation efficiencies and drainage requirements. *In: Proceedings of ASCE Intl. Conf. on Water Resources Engr., Seattle, WA.*

- Grismer, M.E.** 2000. Drainage channel design and restoration of inter-tidal marshes. Keynote Address In: Proc. of Int'l Symposium on Lowland Technology, Saga University, Japan. Oct. pp.57-73.
- Tod, I.C., K. M. Bali and **M.E. Grismer**. 2002. Irrigation efficiencies and drainage requirements. In: Proceedings of USICID Conf., San Luis Obispo, CA. July.
- Wallender, W. W. and **M.E. Grismer**. 2002. Irrigation hydrology: Crossing scales. In: Proceedings of USICID Conf., San Luis Obispo, CA. July.
- Grismer, M.E.** 2002. Constructed wetland hydraulics and water treatment. In: Proc. of Int'l Symposium on Lowland Technology, Saga University, Japan. Sept. pp. 465-472.
- Shepherd, H. L. and **M.E. Grismer**. 2003. Constructed Wetlands for Treating Winery Process Wastewater: Application & Field Results. Conference Proceedings of CA Chapter of ASA Plant & Soil Conf., Modesto, CA. Feb., 2003. pp. 108-114.
- Bali, K.M., I.C.Tod and **M.E. Grismer**. 2003. Linking irrigation practices to the quality of drainage waters. In: Proceedings of USICID Conf. Sacramento, CA. Feb.
- Shepherd, H. L. and **M.E. Grismer**. 2003. Disposal and Use of Winery Process Wastewater - Salinity Issues. ASEV Annual Meeting. Reno, NV. June.

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- Moore, J. A., **M. E. Grismer**, S. R. Crane and J. R. Miner. 1983. Modeling dairy waste management systems influence on coliform concentration in runoff. Trans. of ASAE 26(4): 1194-1200.
- Tanji, K. K., **M. E. Grismer**, and B. R. Hanson. 1985. Subsurface drainage evaporation ponds. Cal. Agriculture 39(9-10):10-12.
- Grismer, M. E.**, D. B. McWhorter, and A. Klute. 1986. Determination of diffusivity and hydraulic conductivity in soils at low water contents from nondestructive transient flow observations. Soil Science 141:10-19.
- Grismer, M. E.**, D. B. McWhorter, and A. Klute. 1986. Monitoring water and salt movement in soils at low solution contents. Soil Science 141:163-171.
- Grismer, M. E.** 1986. Nondestructive observations of solution displacement in soils. Soil Science 141:185-189.
- Grismer, M. E.** 1986. Pore-size distributions and infiltration. Soil Science 141(4):249-260.
- Grismer, M. E.** 1987. Kinetics of water vapor adsorption on soils. Soil Science 143(5):367-371.
- Gates, T. K. and **M. E. Grismer**. 1987. Optimal management of saline water tables in irrigated regions. Cal. Agriculture 41(3-4):20-21.
- Grismer, M. E.** and R. C. Woodring. 1987. Assessment of lateral groundwater flows in the San Joaquin Valley. Cal. Agriculture 41(3-4):22-23.
- Rashmawi, E. A. and **M. E. Grismer**. 1987. Groundwater flows to the San Joaquin River. Cal. Agriculture 41(5-6):18-19.
- Grismer, M. E.** 1987. Vapor adsorption kinetics and vapor diffusivity. Soil Science 144(1):1-6.
- van der Tak, L. D. and **M. E. Grismer**. 1987. Irrigation, drainage and soil salinity in cracking soils. Trans. of ASAE 30(3):740-744.
- Grismer, M. E.** 1987. Water vapor adsorption and specific surface. Soil Science 144(3):233-236.
- Grismer, M. E.** and B. L. McCullough-Sanden. 1988. Evaporation pond seepage. Cal. Agriculture 42(1):4-5.
- Grismer, M. E.** and T. K. Gates. 1988. Estimating saline water table contributions to cotton water use. Cal. Agriculture 42(2): 23-24.

- Grismer, M. E.** 1988. Vapor transport during solution displacement in soils. *Soil Science* 146(4):215-220.
- Grismer, M. E.** 1988. Water vapor adsorption kinetics and isothermal infiltration. *Soil Science* 146(5):297-302.
- Alemi, M. H., D. A. Goldhamer, **M. E. Grismer**, and D. R. Nielsen. 1988. Elution of selenium from contaminated evaporation pond sediments. *J. Environ. Qual.* 17:613-618.
- McCullough-Sanden, B. L. and **M. E. Grismer**. 1988. Field analysis of seepage from drainwater evaporation ponds. *Trans. of ASAE* 31(6):1710-1714.
- Grismer, M. E.**, I. C. Tod, and F. E. Robinson. 1988. Subsurface drainage system performance after 20 years of operation in the Imperial Valley. *Cal. Agriculture* 42(3):24-25.
- Grismer, M. E.**, T. K. Gates, and B. R. Hanson. 1988. Irrigation and drainage strategies for salinity problem areas. *Cal. Agriculture* 42(5):23-24.
- Gates, T. K., R. J-B. Wets, and **M. E. Grismer**. 1989. Stochastic approximation applied to optimal irrigation and drainage planning. *J. Irr. & Drain.* ASCE 115(3):489-503.
- Gates, T. K. and **M. E. Grismer**. 1989. Irrigation and drainage strategies in salinity-affected regions. *J. Irr. & Drain.* ASCE 115(2):258-287.
- Grismer, M. E.**, and B. L. McCullough-Sanden. 1989. Correlation of laboratory analyses of soil properties and infiltrometer seepage from drainwater evaporation ponds. *Trans. of ASAE* 32(1):173-176.
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- Tanji, K. K. and **M. E. Grismer**. 1990. Evaluation of drainwater evaporation ponds. WRC Center final report.
- Lima, L. A., **M. E. Grismer**, and D. R. Nielsen. 1990. Salinity effects on Yolo loam hydraulic properties. *Soil Science* 150(1):451-458.
- Grismer, M. E.** 1990. Leaching fraction, soil salinity, and drainage efficiency. *Cal. Ag.* 44(6):24-27.
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- Weight, G., A. Orhun and **M. E. Grismer**. 1992. Automated power generation for measurement of subsurface drainage flows. *Applied Engineering in Agriculture*. 8(6):795-797.
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